from a single room thermostat. The wide use of this particular means of control is primarily due to the fact that it is the form of regulation best adapted to residences and small buildings, which far out-number the larger structures. In larger buildings, this form of control has definite shortcomings. In the small buildings and average size residences it is possible to select a location and install a thermostat of suitable characteristics which, in controlling from the surrounding air temperature, will hold the temperature of the entire building within entirely satisfactory limits. It must be recognized that the thermostat reacts to and controls from the temperatures to which it is subjected and that, therefore, the position selected for the thermostat must be representative of general conditions throughout the structure. It must further be recognized that if certain areas or rooms of a structure are not properly balanced as regards heating or cooling capacity and distribution, the control as dictated by the thermostat will not produce satisfactory results in these unbalanced areas.

3. *Zone Control.* As the size of buildings increases, it becomes increasingly difficult to provide proper regulation for the entire structure from a single thermostat control. In such instances, where the advantages of individual room control are not obtainable by reason of its cost, an intermediate form of control system is available, commonly described as *zone control.* In this form of control system a building is divided into areas or zones such that the general requirements and the general conditions through the areas are relatively constant as to exposure and occupancy, and then each zone is provided with control equipment which functions to regulate the conditions in that particular zone. As in the case of individual room control, each zone may be regulated to its own needs which may vary from the needs of other zones within the same structure.

Variations of the usual zone control methods by the use of recently developed special devices have been quite successful in obtaining greater economy from heating systems. Frequently these use an outside thermostat or group of thermostats which adjust the operation of the controls to conform to variations in weather conditions.

CENTRAL FAN SYSTEMS

A central fan system includes any conditioning system by which either outdoor air, return air, or combinations of outdoor and return air, are conditioned at a central point and then distributed through duct work to the various sections of the space being conditioned.

Heating Cycle

Central fan ventilating systems may be sub-divided, first into split systems, by which air is supplied for ventilating purposes only and heat is supplied in winter from another source such as direct radiation; and second, into combined systems, in which the functions of ventilation and heating are both performed by the central fan system.

A control system for a central fan ventilating system using all outdoor air and discharging air at a predetermined temperature is illustrated in Fig. 2. Thermostat T_1 located in the outdoor air intake is set just above freezing, and controls valve V_1 on the first heating coil. This valve must

be completely open or completely closed to avoid danger of freezing. The by-pass damper around the heaters and the other two valves V_2 and V_3 are controlled by thermostat T_2 located in the discharge duct from the fan. If the temperature of the discharge air increases, through the action of T_2 the damper is moved automatically to admit more cold air. Should this not reduce the temperature sufficiently, the valves V_2 and V_3 on the heating coils will be closed gradually and in sequence until the correct temperature is reached. The control of the damper and valves V_2 and V_3 must be gradual or there will be a wide fluctuation in temperature.

In ventilating systems it is customary to supply air to the ventilated spaces at an inlet temperature approximately equal to the temperature maintained in the rooms. The radiators therefore are designed to take care of all the heat losses from the room and in order to maintain controlled room temperatures it is necessary to control the radiators independently of the ventilation control.

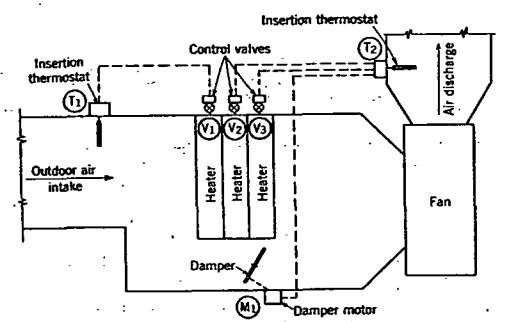

FIG. 2. CONTROL OF A SPLIT SYSTEM OF VENTILATION

In some installations, such as theatres and auditoriums, it is difficult to install sufficient direct heating surface to offset the heat losses from the room. There are also installations where a short heating-up period is allowed before occupancy of the room, and in these cases it is necessary to use the entire heating capacity of the ventilating system for this purpose. An additional thermostat may be installed in the room which will take the control away from the fan discharge thermostat (T_2 in Fig. 2) and utilize the full heating capacity when the room is below normal temperature.

In central fan systems, air washers are often used and in such cases, due to the effect of temperatures on humidity, additional control is required. An arrangement with control of the second tempering heating coil from the air washer temperature and with the usual control of the first tempering heating coil from the outside temperature is shown in Fig. 3. This permits the air to be kept cool while passing through the washer so that too much moisture will not be absorbed. Control of the reheating units and by-pass damper by an insertion thermostat in the fan discharge, and the application of a pilot thermostat to a system of this sort is illustrated in Fig. 3.